

AD-A147 209

PACKING CRATING AND HANDLING COSTS FOR FOREIGN MILITARY  
SALES CUSTOMERS(U) LOGISTICS STUDIES OFFICE (ARMY) FORT  
LEE VA G S GARFINKEL ET AL. SEP 84 LSO-038

1/1

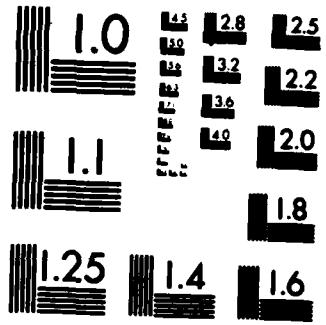
UNCLASSIFIED

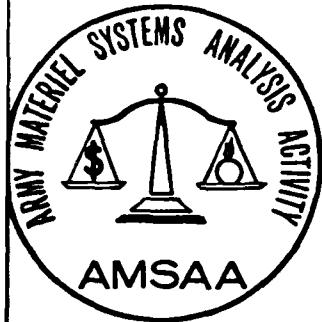
F/G 5/3

NL

AMSA

END





# AMSAA

LOGISTICS STUDIES OFFICE

AD-A147 209

PROJECT NUMBER 038

FINAL REPORT

PACKING, CRATING, AND HANDLING COSTS FOR  
FOREIGN MILITARY SALES CUSTOMERS

SEPTEMBER 1984

AMERICAN  
STANDARD  
TIME  
SEPTEMBER 1984

FILE COPY

U. S. ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY  
LOGISTICS STUDIES OFFICE  
FORT LEE, VIRGINIA 23801-6046

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

84 11 08 016

#### **DISCLAIMER**

The views, opinions, and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

#### **PEER REVIEW**

This report has been conscientiously reviewed by Messrs. Richard D. Abeyta, Operations Research Analyst, and Edward F. Glavan, Jr., Operations Research Analyst.

## UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
		AD-A147 209
4. TITLE (and Subtitle)  Packing, Crating, and Handling Costs for Foreign Military Sales Customers	5. TYPE OF REPORT & PERIOD COVERED  Final Report	
7. AUTHOR(s)  Gerald S. Garfinkel Paul E. Grover	6. PERFORMING ORG. REPORT NUMBER  LSO Project 038	
9. PERFORMING ORGANIZATION NAME AND ADDRESS  Logistics Studies Office US Army Materiel Systems Analysis Activity Fort Lee, VA 23801-6046	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS  US Army Materiel Development & Readiness Command, ATTN: DRCCP-FPI, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001	12. REPORT DATE  September 1984	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	13. NUMBER OF PAGES  61	
	15. SECURITY CLASS. (of this report)  Unclassified	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES  The views, opinions, and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Foreign Military Sales; Depots; <del>Packaging</del> ; <del>Packing</del> ; <del>Crating</del> ; Accessorial Surcharge; <del>Packing</del> ; Linear Regression; Handling Costs.  A		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  Foreign Military Sales customers are charged a surcharge rate on the item selling price to compensate for the cost of packing, crating, and handling (PCH) at Army depots. The present surcharge rate is 3.5% on the first \$50,000 and 1.0% on the remainder of the unit price. Regression analysis indicates the present rate is probably adequate to recover depot PCH costs. It is recommended that the depots should maintain records of accumulated shipment dollar values and that this data be used in future regression analyses to validate the PCH surcharge rate. <i>Foreign Military Sales customers are charged a surcharge rate on the item selling price to compensate for the cost of packing, crating, and handling (PCH) at Army depots. The present surcharge rate is 3.5% on the first \$50,000 and 1.0% on the remainder of the unit price. Regression analysis indicates the present rate is probably adequate to recover depot PCH costs. It is recommended that the depots should maintain records of accumulated shipment dollar values and that this data be used in future regression analyses to validate the PCH surcharge rate.</i>		

**PACKING, CRATING, AND HANDLING COSTS FOR  
FOREIGN MILITARY SALES CUSTOMERS**

**LOGISTICS STUDIES OFFICE  
PROJECT NUMBER 038**

**FINAL REPORT  
SEPTEMBER 1984**

**GERALD S. GARFINKEL  
PAUL E. GROVER**

**LOGISTICS STUDIES OFFICE  
US ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY  
FORT LEE, VIRGINIA 23901-6046**

## ABSTRACT

Foreign Military Sales customers are charged a surcharge rate on the item selling price to compensate for the cost of packing, crating, and handling (PCH) at Army depots. The present surcharge rate is 3.5% on the first \$50,000 and 1.0% on the remainder of the unit price. Regression analysis indicates the present rate is probably adequate to recover depot PCH costs. It is recommended that the depots should maintain records of accumulated shipment dollar values and that this data be used in future regression analyses to validate the PCH surcharge rate.



A-1

Report Title: Packing, Crating, and Handling Costs for Foreign Military Sales Customers

Study Number: LSO 038

Study Initiator and Sponsor: US Army Materiel Development and Readiness Command (DRCCP-FPI)  
5001 Eisenhower Avenue  
Alexandria, VA 22333

#### ACKNOWLEDGEMENTS

Many people have been helpful in obtaining data and in explaining the depot PCH system to us. The authors wish to give particular thanks to Don Muddiman at the USA Security Assistance Center; Blake Auxt, Ken Darhower, Jim Manfred, and Betty Wentz of New Cumberland Army Depot; Miriam Porter and Julia Rotz of the Depot Systems Command; and Jackie Hawkins of Red River Army Depot.

Our colleague, W. H. "Bris" Brisendine, has provided helpful advice and information. As usual, Mrs. Jewel Loftis has been very patient, prompt, and accurate in her typing of the manuscript.

## TABLE OF CONTENTS

	<u>Page</u>
Disclaimer . . . . .	Back of Cover Sheet
Abstract . . . . .	i
Acknowledgements . . . . .	ii
Table of Contents . . . . .	iii
List of Tables and Figures . . . . .	iv
<b>Executive Summary</b>	
1. Authority for the Study . . . . .	1
2. Problem Statement . . . . .	1
3. Objectives . . . . .	1
4. Limits and Scope . . . . .	2
5. Methodology . . . . .	2
6. Findings and Conclusions . . . . .	2
7. Recommendations . . . . .	4
<b>Main Report</b>	
I. Background . . . . .	5
II. Objectives . . . . .	6
III. Limits and Scope . . . . .	6
IV. Assumptions . . . . .	6
V. Related Studies and Documents . . . . .	7
VI. Methodology . . . . .	13
A. Definition of Packing, Crating, and Handling . . . . .	13
B. Methodologies to Obtain Cost Data . . . . .	15
VII. Analysis and Discussion . . . . .	17
A. High Cost Items . . . . .	17
B. Linear Regression Methodology and Results . . . . .	17
C. Interpreting the Results . . . . .	28
D. Trend Analysis . . . . .	33
E. Methodologies for Future Updates . . . . .	34
VIII. Findings and Conclusions . . . . .	38
IX. Recommendations . . . . .	40
References . . . . .	41
<b>Appendices</b>	
A. The Army Management Structure . . . . .	A-1
B. Red River Army Depot Data . . . . .	B-1
C. Combined Army Depot Data . . . . .	C-1
D. Acronymns . . . . .	D-1

## TABLES AND FIGURES

<u>Table</u>		<u>Page</u>
1	PCH Identifiable Codes Within the Supply Depot Operations Series (721111.XXXXXXX)	14
2	FY 78 FMS Lines	24
3	Regression Values for Model 3 (With Fixed Term)	27
4	Regression Values for Model 4 (No Fixed Term)	27
5	90% Confidence Interval for FMS Cost Rate	31
6	FMS Percentage Cost Rates	32

<u>Figure</u>		
1	DOD Survey Results - July 1977	11
2	Depot PCH Process	19
3	PCH Cost Per Line in Current \$	35
4	PCH Cost Per Line in Constant \$ FY 83	35

## EXECUTIVE SUMMARY

1. Authority for the Study. A Study Directive dated 5 December 1980, subject: Packing, Crating, and Handling Cost, was prepared by the Director of Plans and Analysis, US Army Development and Readiness Command (DARCOM), and sent to four study organizations. The Logistics Studies Office was selected to begin the analysis on 13 January 1981.

2. Problem Statement. Department of Defense policy is to ensure that the Foreign Military Sales (FMS) program produces neither profit nor loss to the US Government. In accordance with this policy, foreign customers are assessed a surcharge to recoup the cost of Packing, Crating, and Handling (PCH) of materiel at Army depots. The PCH surcharge for items with unit price under \$50,000 is 3.5%. For higher cost items, the PCH surcharge is 3.5% on the first \$50,000 of the unit price plus an additional 1% on the remaining portion of the unit price. DARCOM is required to review the adequacy of this PCH surcharge rate at least once every two years.

3. Objectives.

a. To determine the validity of the current formula for recouping the cost of Army depot PCH functions for FMS customers. A subobjective is to determine the correct surcharge rate if the present formula is not valid.

b. To develop a methodology for future periodic reviews of the adequacy of the PCH surcharge rate.

4. Limits and Scope. Alternative pricing methodologies to the percentage surcharge method will not be addressed.

5. Methodology.

a. The present PCH rate is adequate if the average PCH cost for FMS shipments is 3.5% of the average dollar value of FMS shipments. This average FMS shipment dollar value was estimated from an analysis of data obtained from the US Army Security Assistance Center on a set of 83,000 FMS shipments. Estimating the average PCH cost for FMS shipments was more difficult since the Army depots generally do not separately record their cost for FMS work.

b. After considering various alternatives it was decided to use a regression approach to estimate the average PCH cost for FMS. The regression model uses the FMS and the non-FMS line item counts as the independent variables and total depot PCH costs as the dependent variable. Red River Army Depot (RRAD) separately records selected PCH costs for FMS. Thus the model was validated by applying it to RRAD data and comparing the resulting estimate with the "actual" average PCH cost at Red River.

6. Findings and Conclusions.

a. Given the available data sources, the cost of performing PCH work for FMS is difficult to compute or to estimate accurately.

b. There has been intermittent interest in estimating the PCH cost for FMS work. A series of previous studies, both

analytic and interpretative, produced estimated overall PCH cost rates for foreign customers ranging from 0.8% to 10.3%

c. The PCH cost rate varies considerably among depots and is strongly influenced by the average shipment dollar value and total workload volume.

d. The PCH cost rate for FMS work at Red River Army Depot is approximately 5.5%.

e. The number of high cost items (those with unit price greater than \$50,000) is too small to statistically assess the adequacy of the present PCH surcharge formula for these items.

f. There is no apparent source for the total dollar value of all shipments processed through Army depots. Furthermore there is also no available data source for the total dollar value of FMS shipments processed through Army depots.

g. Linear regression analysis of total PCH costs and line item counts for both FMS and non-FMS shipments yields no statistical evidence that the present 3.5% surcharge rate for FMS shipments is invalid.

(1) This regression technique was validated by applying the same analysis to data from Red River Army Depot and comparing the resulting cost estimate to the actual Red River PCH cost.

(2) The precision of this regression technique for estimating the PCH cost was low. Greater precision should be achievable if the dollar values of total FMS and of total non-FMS shipments were made available.

h. There are at least three methodologies to periodically review the PCH surcharge rate. In order of increasing cost and increasing precision, they are:

- (1) Linear Regression Analysis.
- (2) Stratified Sampling Procedure.
- (3) Separate FMS Cost Centers at Army depots.

7. Recommendations.

a. The present 3.5% surcharge rate should be continued for items with unit price less than \$50,000.

b. For items with unit price exceeding \$50,000, the surcharge formula should not be used. Instead, FMS customers should be charged the actual or estimated PCH cost.

c. The Depot Operations Cost and Performance Report (DOCPR), published by the Depot System Command, should be modified to include dollar values (i.e., replacement or actual selling prices) of both total FMS and total non-FMS shipments.

d. Biannual reviews of the PCH surcharge rate should be performed using linear regression analysis applied to line count and dollar value data from the DOCPR.

e. Concurrent with biannual review of the overall PCH costs and surcharge rate, regression analysis should also be used to estimate the PCH cost rate at each depot with considerable FMS shipment volume. Any significant differences in individual depot cost rates should then be further evaluated.

## MAIN REPORT

### I. Background.

A. Beginning with the Foreign Military Sales (FMS) Act (Public Law 90-629) of 22 October 1968, with additional emphasis in the Arms Export Control Act of 1976, the Department of Defense (DOD) is required to manage the sale of military goods and services to foreign nations without either making a profit or subsidizing the sale with taxpayers' dollars. A desire to fairly recoup all costs associated with FMS has resulted in a series of surcharges that are placed on the unit selling price of the item or service. Extra costs that may be charged include a pro rata share of nonrecurring research, development, and production; government furnished materiel and services; modification cost for special configurations; asset use for government facilities; force rearrangement; agent fees; administrative charges; accessorial charges; and asset use charges for articles issued from inventory [1].

B. One such accessorial charge is the cost of removing, preserving, packaging, and packing materiel items (i.e., major and secondary items excluding ammunition and bulk petroleum products) for shipment from government storage facilities. These functions are commonly referred to as packing, crating, and handling (PCH). The PCH surcharge is assessed as follows: For items with a unit price less than \$50,000, the PCH surcharge is 3.5%; for items with greater unit price, the PCH surcharge is

3.5% of the first \$50,000 plus 1% of the remaining portion above \$50,000. The adequacy of the PCH rate has been questioned for years by numerous parties [2,3,4], yet there is little statistical evidence to indicate if 3.5% overcharges or under-charges the customer. Despite a requirement in AR 37-60 that the US Army Materiel Development and Readiness Command (DARCOM) review accessorial charges biannually, attempts have been stymied by the inability to identify PCH cost for FMS activity. The major problem is that the Standard Depot System does not separately account for FMS costs. The purpose of this study is to evaluate the present PCH pricing formula for FMS and to establish an analytical procedure to periodically review PCH rates.

II. Objectives.

A. Objective #1. To determine the validity of the current pricing formula for charging the cost of DARCOM depot PCH functions to the FMS customer. A subobjective is to determine the correct surcharge rate if the present formula is not valid.

B. Objective #2. To develop a methodology for future periodic reviews of the adequacy of the PCH rate.

III. Limits and Scope. Alternative pricing methodologies to the percentage surcharge method will not be addressed.

IV. Assumptions.

A. Financial data obtained from the following sources are accurate:

1. Depot Operations Cost and Performance Report (DOCPR), RCS DRCMM-305, FY 78 - FY 83, quarterly [5].

2. US Army Security Assistance Center computer tape records on 83,000 FMS shipments in FY 82 and FY 83.

B. PCH costs for labor and material are proportional to workload. As PCH workload fluctuates, workers are reassigned to/from other depot activities or work overtime.

C. The average PCH cost per line item in constant dollars has remained stable from FY 78 to FY 83.

D. PCH costs as defined in AR 37-60 can be identified by Army Management Structure (AMS) codes in the 721111 series, Supply Depot Operations. Further assumptions made in this regard are:

1. For inflation adjustments, all PCH costs were assumed to be 10% material and 90% labor.

2. Freight cost (721111.3100) for a shipment equals freight cost for a receipt.

E. The average PCH cost for International Logistics (FMS and Grant Aid) shipments is not significantly different from that of FMS shipments.

V. Related Studies and Documents. Although the rationale for charging FMS customers for PCH activities has not been challenged, the issue of the validity of the 3.5% surcharge has persisted. The following chronology of reports and documents describes previous efforts to quantify the PCH costs and to identify the perceived problems.

A. 7 March 1967 - DOD Instruction 2140.1, "Pricing of Sales of Defense Articles and Defense Services to Foreign Countries and International Organizations" [6]. This DODI defines "standard price," accessorial costs and packing, handling, and crating costs. Exempting bulk petroleum, oils, and lubricants and certain major items, a uniform 3.5% surcharge is specified for items of under \$10,000 unit price. Actual or estimated costs are to be used for items with unit price of \$10,000 or over. This DODI refers to DODI 7510.4, "Uniform Policy for Charging Accessorial and/or Administrative Costs Incident to Sales and Transfers of Materials, Supplies, and Equipment." The methodology for deriving the 3.5% is unknown. It is surmised that the factor predates 1967.

B. April 1975, Packaging Cost Study: Military Packaging versus Commercial Packaging, Project Report TP 20-75, by Michael Noll, US Army Materiel Command Packaging, Storage and Containerization Center [7]. For a sample of 488 contracts from 5 Army commodity commands, separate contractor bids were submitted to cover the cost of packaging to both military specifications and commercial specifications. Military packaging averaged 6.25% of unit price and commercial packaging averaged 3.02%. The logic of later inferences about the relevance of the 6.25% factor to PCH surcharge rates is strained by the following points:

1. PCH cost for FMS is incurred by depots, not contractors.

2. Depot packaging is generally much more heterogeneous compared to contractor packaging operations.

3. The items sampled in this study are for generally greater quantities and higher unit prices than a typical FMS shipment.

C. 19 August 1977 - General Accounting Office (GAO) Report LCD-77-210, Improvements Are Needed to Fully Recover Transportation and Other Delivery Costs Under the Foreign Military Sales Program [2]. Citing [7] and an unpublished<sup>1</sup> survey made by the Naval Supply Center in June 1975 where packing was estimated to be 10.3% of materiel value, GAO criticized DOD for wasting \$71 million in unrecovered PCH cost in 1976. GAO argued that since FMS items are normally preserved and packaged at the highest military standard levels of protection (level A), the FMS PCH rate should be 6.25% instead of 3.5%.

D. September 1977 (approx) - In response to the GAO report [2], DOD initiated a survey of PCH rates on 7 June 1977 [8]. Based on a "random" sample of 869 packing cases for FMS shipped in July 1977 from 22 DOD depots, DOD found the average PCH rate to be 0.8% and concluded that the 3.5% rate should be retained. The sample, at least from the Army perspective, was unrepresentative. New Cumberland Army Depot, which in FY 82 accounted for 32% of all FMS Material Release Orders (MRO), was omitted from the sample. On the other hand, included was Pueblo Army Depot

---

<sup>1</sup>Authors unable to locate a report

which shipped 0.028% of the FMS MROs in FY 82. A significant observation was made that the PCH rate is inversely related to the value of the shipment (see Figure 1). Low value shipments have high PCH rates and expensive shipments have low PCH rates. Thus, depending on the mix of high to low value shipments in a sample, the PCH rate can be highly variable. A surcharge rate can only recoup costs in the long run by balancing "profits" on high value items with losses on low value items.

E. 21 October 1977. The Comptroller of the Army requested a change in PCH rates from 3.5% to 6.25% [4]. DOD responded negatively, revising the DODI to reflect the pricing formula shown in the next paragraph.

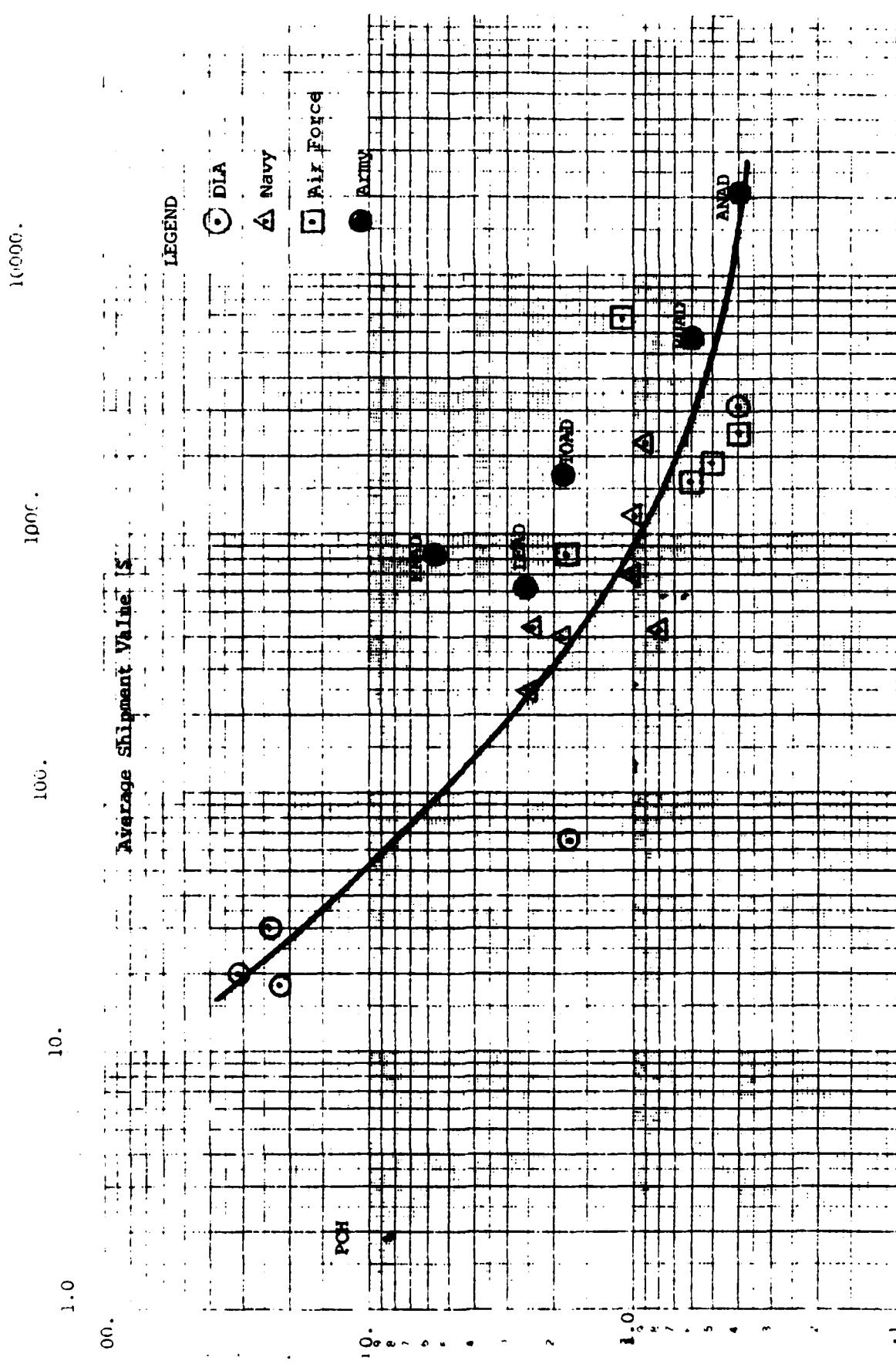
F. 9 February 1978, AR 37-60 [9] was modified to charge 3.5% on materiel with a unit selling price of less than \$50,000; for higher value items, a 3.5% surcharge on the first \$50,000 and 1% on the amount over \$50,000 was specified. This is the pricing formula currently in effect in the 15 April 1983 edition of AR 37-60 [10]. AR 37-60 [9,10] also contains a requirement that DARCOM review PCH rates at least every two years.

G. 3 August 1978, Internal Review - Depot Systems Command (DESCOM) IR-6-78 [4]. Referring to an unpublished July 1977 DARCOM sample PCH rate of 5.46% and the GAO [2] rate of 6.25%, DESCOM estimated that annual Operations and Maintenance,

---

libid

FIGURE 1. DOD Survey Results - July 1977



Army (OMA) reimbursements from FMS were \$1.9 million below actual costs for PCH.

H. December 1978, Analysis of Depot Packaging Cost Reporting, HQ DARCOM Project Report 27-77 [11]. Using DOCPR data, an inverse relationship ( $R=-.80$ , 2 degrees of freedom) was found between production volume and per unit preservation and packaging for shipment cost (AMS code 721111.13314). The report concluded, "Total labor and overhead costs for a packaging operation remain roughly constant while workload may fluctuate considerably." Thus, an important factor in determining actual PCH cost for an FMS item is the volume of concurrent work at the depot.

I. 22 August 1980, Internal Review, DESCOM, IR-25-80 [12]. Noting a lack of corrective action on [4], DESCOM requested that DARCOM initiate a study on the PCH rate problem. DARCOM verbally tasked the Logistics Studies Office on 13 January 1981.

J. 6 July 1983, Fact Sheet, Red River Army Depot (RRAD), subject: Packing, Crating, and Handling (PC&H) Cost in Support of IL Shipments [13]. International Logistics (IL) shipments include Grant Aid as well as FMS. RRAD had created separate cost cells within its accounting structure for IL functions and was able to determine the PCH rate for FY 82 to be 5.4%. The average value per line was \$1320 and the average PCH cost was \$71.32. Total unrecouped OMA cost in FY 82 was estimated to be \$956,066 at Red River. The results of this study were consistent with the July 1977 DOD survey [8] in which the RRAD

rate was 5.8%. The fact sheet noted that RRAD usually repackages, represerves, and re-marks FMS shipments; a practice that may be less prevalent at other Army depots.

## VI. Methodology.

### A. Definition of Packing, Crating, and Handling.

1. The official definition of PCH can best be found in DOD 7290.3M, Foreign Military Sales Financial Management Manual, 29 June 1981 [14] which states:

"Packing, Crating and Handling (PC&H) Cost. The cost incurred in DOD facilities for labor, materials, and services in removing requisitioned articles from storage locations, preparing them for shipment from the storage or distribution points and processing necessary materiel release confirmation documents.. These costs are incurred on all articles sold from stock to FMS customers."

2. To translate the DOD definition into the form of available data, PCH in this study is defined to include certain costs reported by Army depots via Army Management Structure (AMS) Codes contained in AR 37-100-XX [15]. Table 1 contains the AMS codes that apply to PCH. A more detailed definition of each AMS code is contained in Appendix A.

TABLE 1

PCH IDENTIFIABLE CODES WITHIN THE SUPPLY DEPOT  
OPERATIONS SERIES (721111.XXXXXXX)

AMS CODE	ACTIVITY
1211400	Packing for Shipment - Other Supplies (OS)
1220000	Bulk Issue
1230000	Bin Issue
1244000	Shipping - OS
1292000	Packing and Issue Support <sup>1</sup>
1331400	Preservation and Packaging for Shipment - OS
1344000	Container Assembly or Manufacture - OS
1433520	Quality Control - Preservation, Packaging, Packing - Shipment OS
1434200	Quality Control - Shipping Inspection - OS
1442300	Transshipment - Inspection - Other than DSS
3100000	Traffic Management - Freight <sup>2</sup>

<sup>1</sup>AMS code is not separately included in reports but is an indirect expense that is included in the other AMS codes.

<sup>2</sup>Only part of this AMS code is related to PCH.

B. Methodologies to Obtain Cost Data. The major difficulty in this study concerned the obtaining of actual or estimated cost in performing PCH processing for FMS shipments. The depot cost accounting procedures allocate costs among the various functional cost centers. These accounting procedures do not separately accumulate costs for FMS customers. Three different methodologies to obtain the cost of processing FMS shipments were explored.

1. Automated File Data. The initial study approach to the problem of estimating PCH costs was to collect depot financial data contained in the Standard Depot System (SDS). This methodology was based on the premise that the PCH cost is a function of the level of pack (level A, B, etc). Level "A" pack PCH costs are assumed to be the same regardless of whether the customer is FMS or not. From the Materiel Release Orders (MRO), data would be collected on the value of the shipment and on the costs charged to those cost centers associated with PCH functions. This methodology was abandoned when it was discovered that:

- a. The MRO history file does not explicitly specify the level of pack.
- b. Not all FMS shipments are packed at Level A.
- c. SDS does not identify the FMS selling price by MRO
- d. PCH costs are not normally reported against a particular MRO.

e. Depot costs for FMS work are integrated into the system and generally cannot be extracted separately.

Due to these data limitations a less direct approach was necessary.

2. Sampling Procedure. The second methodology explored was the obtaining of cost data on a random sample of shipments. To ensure that the sample was representative with respect to unit and shipment prices and commodity type, a retrospective sampling procedure was developed. The US Army Security Assistance Center (USASAC) provided a magnetic tape with data on 83,000 FMS shipments during the period March 1981 to March 1982. From this collection a stratified sample of 400 shipments was selected. For each sample item, the National Stock Number, nomenclature, unit price, weight, cube, and other information was ascertained. About 60% of both the total USASAC collection and the selected sample consisted of shipments from New Cumberland Army Depot (NCAD). Responsible elements at the various NCAD cost centers were asked to estimate the functional processing cost for each NCAD sample shipment. Such estimates were obtained for various PCH functions. However, cost estimates for exterior packing were not obtainable since a particular line item may be consolidated and put into a common exterior pack with other line items going to the same customer. Thus, the cost of packing a specified quantity of a particular item will depend on how large a shipment with which it is consolidated. This packing function is one of the most expensive PCH

components. Moreover, the packing standard, and thus the packing cost, is often higher for an FMS customer than for a non-FMS customer. Thus, the lack of these critical packing cost estimates invalidated the sampling procedure methodology.

3. Linear Regression. The last methodology considered was the use of linear regression. The basic concept was to start with the total PCH costs for both FMS and non-FMS shipments and then use regression techniques to apportion this combined total cost into a total cost for FMS and a total cost for non-FMS shipments. This is the methodology actually used in this study and is described in detail below.

#### VII. Analysis and Discussion.

A. High Cost Items. For items with unit price over \$50,000 the present surcharge is 3.5% of \$50,000 plus 1.0% of the amount the unit price exceeds \$50,000. The USASAC data set of 83,000 FMS shipments contained only seven line items with unit price over \$50,000. This is too small a set of high cost items to test the validity of the high cost portion of the surcharge formula. The USASAC data set represents about one quarter of all the depot FMS shipments. Thus, there are probably about 30 annual depot FMS shipments of items with unit price in excess of \$50,000. Therefore, it should not be too burdensome for the depots to estimate or measure the actual PCH cost for processing these line items.

B. Linear Regression Methodology and Results. There were various major difficulties in implementing this methodology

and consequently the results are somewhat limited. However, this methodology was the most usable of the three considered and also is the most feasible for use in future periodic reviews of the adequacy of the PCH surcharge rate. Therefore this methodology was implemented and its results form the statistical basis for this study.

1. Basic Assumptions.

a. The PCH concept comprises various depot functions and Army Management Structure (AMS) subcodes. See Figure 2 and Table 1. The cost to perform certain of these functions - such as packaging, preserving, and packing items - depends on factors such as the complexity, fragility, and dollar value of the items. The items which are more complex and vulnerable to damage tend to also be the more expensive ones. Thus, the cost to perform these functions should depend on the total dollar value of shipments. Other functions, such as the issue of items from bin or bulk storage, tend to be independent of the nature or value of the items. Thus, the total depot expense in performing these functions should depend on the total number of shipments processed.

b. For various reasons, shipments to foreign customers often receive greater protection, more visibility and thus more expensive processing. Therefore, the total depot PCH expense in processing all shipments should depend on the number and dollar value of FMS shipments as well as the number and dollar value of non-FMS shipments.

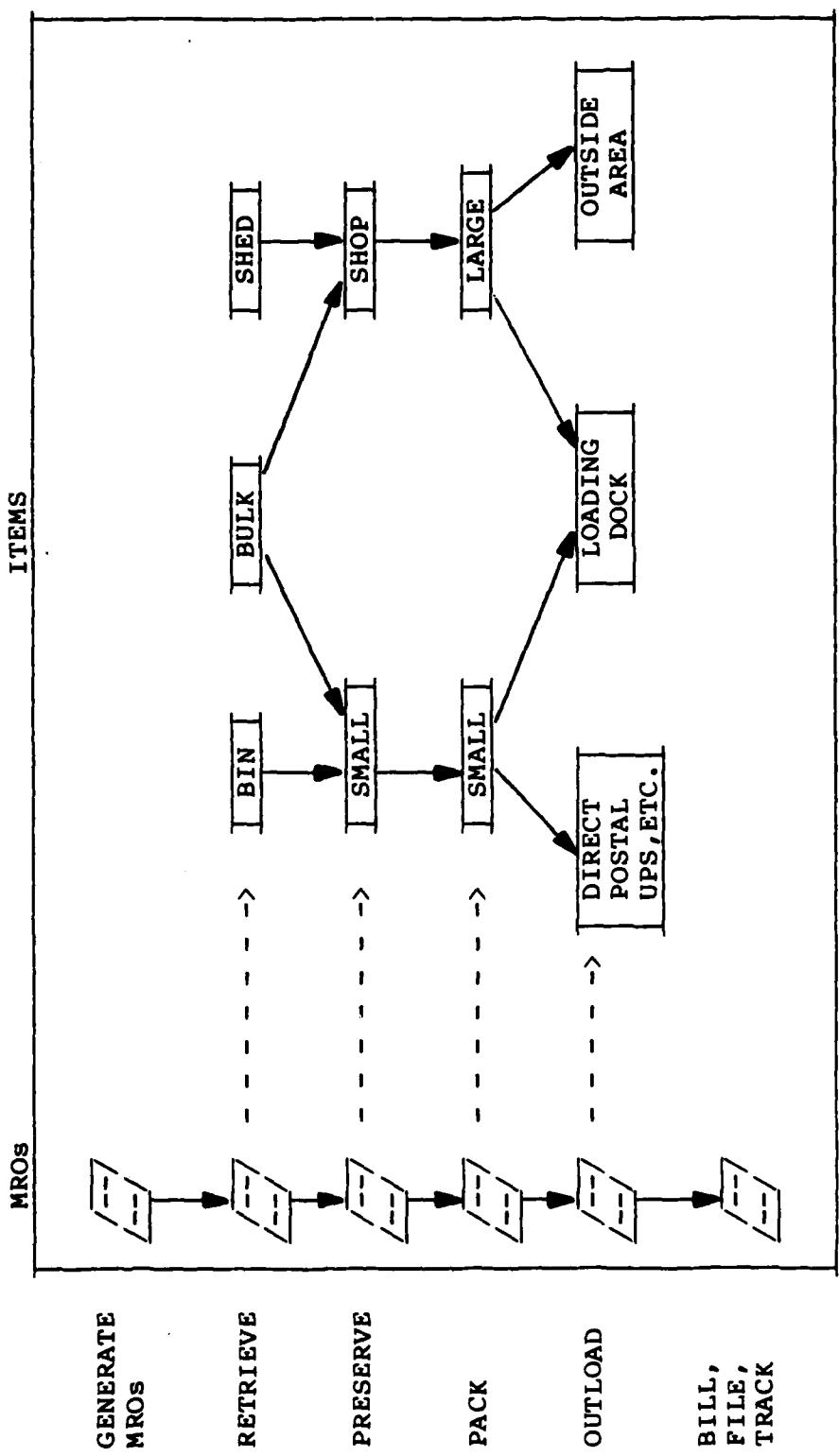


FIGURE 2. Depot PCH Process

2. The Complete Model. Based on the assumptions stated above the complete linear regression model is:

$$(1) \quad T = \alpha N + \beta M + \gamma V + \delta W + \epsilon .$$

Here the greek letters  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ , and  $\epsilon$  are unknown constants (the parameters of the model). Given an arbitrary period of time (in practice a fiscal quarter - 3 months) the variables are defined as follows:

T = Total depot PCH expense in dollars,

N = Number of FMS shipments,

M = Number of non-FMS shipments,

V = Total dollar value of FMS shipments,

W = Total dollar value of non-FMS shipments.

$\epsilon$  in the above model represents the fixed cost of performing PCH work, i.e., those costs not directly related to the volume or value of the shipments being processed. In the absence of this fixed cost, evaluation of the remaining parameters would permit an apportioning of the total PCH cost into a total PCH cost for FMS and a total PCH cost for non-FMS work. Removing the fixed cost then yields the model

$$(2) \quad T = \alpha N + \beta M + \gamma V + \delta W.$$

### 3. Data Elements.

#### a. PCH expenses.

(1) Table 1 lists the AMS elements and codes which constitute the PCH function. Appendix A contains the official definition of the elements as given in AR 37-100-81. Depot expenses for these elements are recorded in the Depot Operations

Cost and Performance Report (DOCPR) [5]. The expenses for those elements designated as "indirect" are also counted in the indirect component of total expense for the elements designated "direct." Thus, the total PCH cost at depot is defined as the sum of all total expenses for the "direct" elements listed in Table 1.

(2) The "freight" function covers both receiving and shipping. Most of the freight entries record both the number of freight lines received and the number of freight lines shipped. In all cases where both line counts are recorded, the number of lines shipped is substantially greater than the number of lines received. Of course, the average line received at a depot contains much more material than the average line shipped from the depot. Only the fraction of total freight expense attributable to shipments is part of the PCH expense. Since this fraction is not recorded in the DOCPR, it was arbitrarily defined as the proportion of freight shipping lines to total freight lines when the freight receiving lines were recorded, and as 0.90 when the freight receiving lines were not recorded.

(3) The current dollar expense amounts were converted to constant FY 82 dollars by using the FY 83 Department of Defense Deflators [16]. These deflators are for separate categories of expense, such as Military Construction, Operations & Maintenance, and Civilian Pay. About half the total PCH expenses were for direct labor and material. Approximately 85% of these direct costs were for labor. Although the remaining costs are

not apportioned into labor and material components, much of these costs are for labor intensive functions such as supervision. Thus, a single deflator index was constructed by assuming that 90% of PCH costs are for Civilian Pay expenses and that 10% of the PCH costs are for material expenses within the Operations and Maintenance category. A sensitivity analysis (see para VII, C4b) showed that changing the civilian labor component cost from 90% to 80% does not substantially affect the study conclusions.

b. FMS and non-FMS lines. The number of FMS lines, Grant Aid lines, and the total number of lines shipped is recorded in the "Evaluations of Shipping Forecasts" report. This report appears in Section C of the DOCPR. Two variables were obtained from this report. The sum of FMS and Grant Aid lines was recorded and labelled as International Logistics (IL) lines. The difference between total lines shipped and IL lines was recorded and labelled as non-IL lines. The reason for using IL lines rather than only FMS lines was for compatibility with the methodology and results in the Red River Army Depot study on PCH [13]. Approximately 95% of the IL shipments are actually for FMS and thus average PCH cost for IL shipments is likely to be about the same as average PCH cost for FMS shipments. See Appendix C.

c. FMS and non-FMS values. The total dollar values of FMS shipments and of all shipments from depots were not obtainable. Dollar values of items and shipments are not contained in the DOCPR. Various other information sources were

queried to no avail. A data request to the US Army Security Assistance Center (USASAC) produced a list of total monthly FMS billings. However, the dollar amounts listed included charges for training and maintenance as well as materiel sales. Moreover, some of the billing reflected credits or error corrections. Thus, some of the monthly totals were actually negative. Clearly such a listing cannot yield a credible dollar amount of FMS shipment values. Other sources queried included HQ DARCOM, the DESCOM Supply Directorate, and the Communications and Electronics Command International Logistics Directorate.

d. The time periods.

(1) The depots send DOCPR data monthly to DESCOM. However, DESCOM only publishes the DOCPR each fiscal quarter with the cumulative data for that fiscal quarter and for the fiscal year to date. Quarterly data from First Quarter, FY 74 through Second Quarter, FY 83 were available. However, due to changes in depot PCH standards as well as the effects of inflation, the per shipment PCH cost may have substantially changed from FY 74 to FY 83. Thus, only the data from FY 78 through the Second Quarter, FY 83 were analyzed.

(2) Some of the FMS line counts from the FY 78 "Evaluation of Shipping Forecasts" report were not usable. The second quarter Anniston and Combined Depot reports both had an annotation stating that Anniston had over-estimated the FMS line count for the Tank Automotive Command by 60,756. In view of this and the data from Table 2, it was decided to

exclude data from the second and third quarters of FY 78 from the regression analysis.

e. Appendices B and C contain listings of the RRAD and Combined Depot data used by the regression analysis.

TABLE 2  
FY 78 FMS LINES

Quarter	Anniston	Sharpe	All Depots
1	6520	33131	104128
2	76649	16306	136463
3	-74439	14018	4745

Source: Evaluations of Shipping Forecasts, DOCPR report, DESCOM

4. The Partial Models.

a. Since the values of V and W in the complete model were not available, the partial model,

$$(3) \quad T = \alpha N + \beta M + \epsilon$$

was studied. Also, for reasons of compatibility with the definitions used in the Red River Army Depot (RRAD) study [13], the Grant Aid shipments were combined with FMS shipments. Grant Aid and Foreign Military Sales are the two components of International Logistics (IL). Thus, the new definitions are:

N = number of IL shipments

M = number of non-IL shipments.

b. In model (3)  $\alpha$  and  $\beta$  represent the "marginal costs," i.e., the costs to ship one more IL or non-IL shipment once the fixed cost,  $\epsilon$ , has been incurred. Thus, " $\alpha N$ " represents the marginal cost in processing all IL shipments.

However, this study is concerned with recouping the total PCH cost, rather than the marginal cost, of processsing all IL shipments. Therefore the model

$$(4) \quad T = \alpha N + \beta M$$

with no constant term was also studied.

#### 5. Formulating the Questions.

a. The objective of this study is to ascertain if the current PCH surcharge is appropriate to recoup depot expense for foreign customers. A reformulation is to ask if the average PCH expense for FMS is 3.5% of the average FMS shipment value.

Thus letting:

C = Average PCH cost for FMS shipments

D = Average dollar value of FMS shipments

the objective is to answer the question,

$$(Q1) \quad C = 0.035 D ?$$

b. If Model 4 is valid, then the parameter  $\alpha$  should approximate C and thus can be used to answer question Q1. Hence, there are two questions to ask about  $\alpha$  :

$$(Q2) \quad \alpha = C ?$$

$$(Q3) \quad \alpha = 0.035 D ?$$

Affirmative answers to questions Q2 and Q3 would provide an affirmative answer to question Q1.

c. Unfortunately the value of C, the average PCH cost for FMS shipments throughout the Army Depot System, is unknown. However, the FY 82 internal study at Red River Army Depot [13] produced an estimated value of \$71.32 for C at Red

River. Thus, applying Model 4 to DOCPR data for Red River, the question for Red River becomes

$$(Q2-RRAD) \quad \alpha = \$71.32 \quad \text{at RRAD ?}$$

An affirmative answer to this question gives assurance that

$\alpha$  does approximate the average PCH cost for FMS shipments at Red River, and thus gives credence to the assumption that question Q2 is true for the Combined Depot System. In other words, if the  $\alpha$  coming from the Red River data provides a reasonable estimate to the accepted average PCH cost for processing FMS shipments at Red River, then the  $\alpha$  derived by applying the same procedure to the DESCOM data will likely also provide a reasonable estimate of the DESCOM-wide average PCH cost for processing FMS shipments.

d. Data from about 83,000 FMS shipments during the period March 1981 until March 1982 were received from the US Army Security Assistance Center (USASAC). The average dollar value of shipments from this data set was \$1180. Thus, question Q3 becomes

$$(Q3-DESCOM) \quad \alpha = \$41.30 \quad \text{at DESCOM ?}$$

#### 6. Technical Results.

a. Calculated values. Linear Regression Analysis was used to fit Models (3) and (4) to both the RRAD and Combined Depot data sets. The technical results are summarized in Tables 3 and 4. In each case the "goodness-of-fit" measurement is:

$$R^2 = 1 - \frac{\text{Residual Sum-of-Squares}}{\text{Total Sum-of-Squares}}$$

The Residual Sum-of-Squares is the sum of the squares of the values  $(\text{Actual PCH Cost} - \text{PCH Cost})^2$  computed from the Model and the Total Sum-of-Squares is the sum of the values  $(\text{Actual PCH Cost} - \text{Average PCH Cost})^2$ . The RRAD and the Combined Depot data sets each had 20 quarters of data. Thus, since Model (3) has three parameters to be estimated, its regression analysis has 17 degrees of freedom. Similarly, Model (4) has only two parameters to be estimated and, therefore, has 18 degrees of freedom.

TABLE 3  
REGRESSION VALUES FOR MODEL 3 (With Fixed Term)

	$\alpha$ (IL coef)	$\beta$ (non-IL coef)	$\epsilon$ (fixed term)	$R^2$
Red River AD				
mean	108.86	16.43	2,144,196.76	0.361
std. error	58.14	5.58	569,631.24	df = 17
Combined Depots				
mean	9.49	16.31	13,794,000.00	0.348
std. error	36.47	5.43	2,104,330.00	df = 17

TABLE 4  
REGRESSION VALUES FOR MODEL 4 (No Fixed Term)

	$\alpha$ (IL coef)	$\beta$ (non-IL coef)	$R^2$
Red River Army Depot			
mean	144.68	22.06	0.319
std. error	47.41	1.65	df = 18
Combined Depots			
mean	35.80	24.43	0.254
std. error	33.68	1.74	df = 18

b. Confidence Intervals. With 18 degrees of freedom, a 90% confidence interval for a Student's t variable is:

mean  $\pm$  1.734 std. error

Thus, for Model (4), the 90% confidence intervals for  $\alpha$  are:

$62.47 < \alpha < 226.89$  at RRAD

$-22.60 < \alpha < 94.20$  at DESCOM.

c. Hypothesis Test Results.

(1) Question 2 (Q2-RRAD) can be interpreted as a hypothesis test. The null hypothesis is that  $\alpha = 71.32$  at RRAD. The alternative is that  $\alpha$  is not equal to 71.32. Since the value  $\alpha = 71.32$  is well within the 90% confidence interval, there is no significant evidence for rejecting the null hypothesis. Thus, the hypothesis  $\alpha = 71.32$  is accepted.

(2) Question 3 (Q3-DESCOM) can also be interpreted as a hypothesis test. The null hypothesis is that  $\alpha = 41.30$  for the Combined Depot System. Since the value  $\alpha = 41.30$  is within the 90% confidence interval, the null hypothesis cannot be rejected.

d. Assuming \$1180 as the average dollar value for an IL shipment, then the maximum likelihood estimate for the PCH cost rate for IL shipments is 3.03%. Using the same average dollar value for non-IL shipments yields a maximum likelihood estimate of 2.07% for the PCH cost rate for non-IL shipments.

C. Interpreting the Results.

1. Answers to the Questions. The hypothesis test results described above essentially show that affirmative answers

to Questions Q2 and Q3 are compatible with the data analyzed. Since the answers to these questions are affirmative, the answer to Question Q1 is also affirmative. Thus, the linear regression analysis yields no significant evidence that the 3.5% PCH surcharge rate should be changed.

2. How accurate is the regression analysis? The values for  $R^2$  are very low. This indicates that the models do not fit the data very well. Also the standard deviation for the estimation of  $\alpha$  is very large. That indicates the estimate for  $\alpha$  is not very precise. This imprecision is also indicated by the very large confidence intervals for  $\alpha$ .

3. Many of the regression analysis problems are due to poor data. Lack of dollar value data for shipments forced the substitution of the partial models (3) and (4) for the full models (1) and (2). Clearly the goodness of fit of these partial models is expected to be substantially less than that of the full model. It is widely believed that PCH for foreign customers is more expensive since the preserving, packaging, and packing functions for them may be performed to a higher standard. The cost to perform these three functions may be closely related to the price of the items and hence of the shipments. Thus, the lack of dollar values may degrade more the estimation precision of the IL coefficient than of the non-IL coefficient. This may account for the fact that the standard deviation of the estimate for  $\alpha$  is substantially greater than that for  $\beta$ . Finally, the data recorded may be inaccurate. As explained above in paragraph

VII-B3d(2), due to obvious gross errors in the FMS shipment counts for two fiscal quarters, data from these fiscal quarters were omitted from the analysis data base. Undetected errors in the data used for the analysis would tend to degrade the results. Such recording errors would tend to decrease the goodness of fit (decrease the  $R^2$  value) and decrease the precision of the parameter estimates (increase the standard deviations).

4. How sensitive are the regression results to the data and to the assumptions?

a. The data from the first quarter of FY 78 is suspect since the data from the second and third quarters is known to be invalid and the number of FMS lines for this quarter is substantially greater than the number of FMS lines for any other quarter.

b. For inflation computation purposes, the labor component for PCH costs was assumed to be 90%. Would the results be significantly different if the labor component were assumed to be 85% or 80%?

c. Additional regression analyses were made with the data from the first quarter of FY 78 omitted and with the labor component assumed to be 80% rather than 90%. The results of these analyses are summarized in Table 5. From this table, it is clear that the results are not sensitive to changing the labor component percentage. From a practical point of view, the true FMS cost rate must be positive. Note that the positive

portions of the intervals in Table 5 are all substantially the same. Thus, the inclusion or omission of the first quarter FY 78 data is not crucial.

TABLE 5  
90% CONFIDENCE INTERVAL FOR FMS COST RATE

1st QTR, FY 78	LABOR 90%	LABOR 80%
Include	-1.92% to 7.98%	-1.68% to 8.41%
Omit	-8.36% to 7.01%	-8.36% to 7.25%

5. How credible are the regression analysis conclusions?

a. As stated above, due to data problems there is much inherent imprecision in the regression results. However, many of the larger trends apparent in the regression analysis are compatible with the results of previous studies. Table 6 compares the cost rates obtained in this study with those of the RRAD study and the 1977 DOD sample.

b. The regression indicates that at Red River Army Depot the cost to process an IL shipment is substantially higher than the cost to process a non-IL shipment. The RRAD study [13] states that this extra cost is due to the fact that many of the items going to foreign customers are completely repackaged and repacked.

TABLE 6  
FMS PERCENTAGE COST RATES

1977 SAMPLE MEANS		RRAD	$T = \alpha N + \beta M + \epsilon$	$T = \alpha N + \beta M$
Weighted*	Unweighted*	1983 Study	Marginal $\alpha$	Unit Cost $\alpha + \epsilon / (N+M)$
RRAD	5.8	5.4	8.2(4.4)	9.0(4.4)
	0.8(1.6)	2.3(1.0)	-	0.8(3.1)
	0.8(4.6)	4.9(1.9)	-	-
ARMY				1.6(3.1)
DOD				-

ESTIMATES (AND THEIR STANDARD ERRORS)

\*  $V_i$  = Selling Price

$$x_i = 100(PCH\ Cost)/(Selling\ Price)$$

c. The regression shows substantially higher IL unit PCH costs at RRAD than at the other depots. Similarly, in the DOD-wide study [8] the RRAD sample had a PCH cost of 5.8% while the overall cost was 0.8%.

D. Trend Analysis.

1. Trend lines were fitted to the combined army depot data contained in Appendix C to determine the dynamic behavior of PCH cost. Total PCH cost in both current and constant dollars was divided by Total Lines and plotted in Figures 3 and 4. It can be observed that PCH cost increases roughly paralleled the general rate of inflation. From the first quarter of FY 78 to the second quarter of FY 83, PCH cost per line in current year dollars increased by an average per annum rate of 5.85%. In real terms, extracting inflation, PCH cost per line actually decreased by 0.75% per year, reflecting some productivity gains. However, this decrease is not statistically significantly different from no change (0%).

2. During this same period of time, the DOD deflators for Procurement (missiles, aircraft, WTCV), Procurement (ammo, communications, electronics, other), and O&M increased by average per annum rates of 9.75%, 9.3%, and 9.3% respectively. The inflation rate for items shipped from depots may exceed these rates based on the recent public criticism of the DOD spare parts acquisition process. In addition, the rate of increase for FMS shipments may exceed the general spare parts inflation rate because FMS customers have been buying more

sophisticated and complex systems in recent years.<sup>2</sup> For example, at Red River Army Depot the average FMS shipment value in FY 82 [13] was 61.6% higher than for a sample of 50 shipments taken in July 1977 [8]--a 10% per annum increase.

3. The PCH rate, the ratio of PCH cost per shipment to the value of the shipment, therefore, is a variable whose numerator has been growing more slowly than its denominator. This phenomenon indicates that the PCH rate today may be less than it was in FY 78. If the rate of increase in dollar value of FMS shipments continues to outpace the rate of inflation for civilian pay, this downward trend will continue into the future.

4. As a result of potential long term trends in the PCH rate, there is a need to periodically review the surcharge. In addition, a periodic review may pinpoint problems, as evidenced by shorter term price increases. For example, from Figure 4 there appears to have been a sudden, rapid increase in PCH cost per line from the second quarter of FY 82 to the middle of FY 83. This may indicate a problem in the PCH area that merits management attention.

E. Methodologies for Future Updates.

1. Regression.

---

<sup>2</sup>The average cost per FMS case increased by 19.5% per year from FY 77-FY 82 [17].

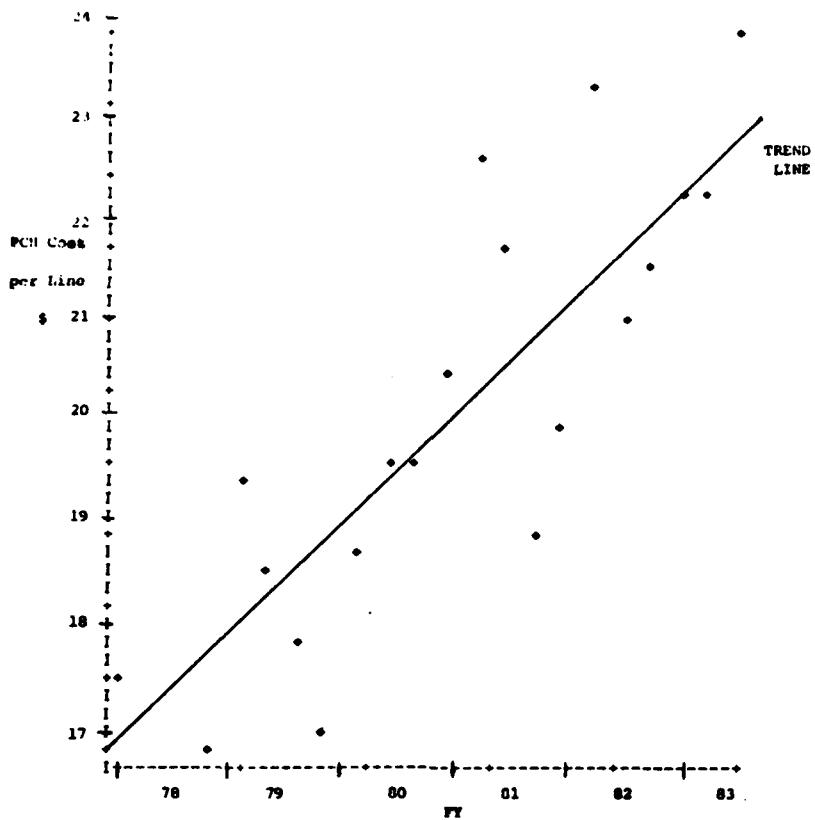


FIGURE 3. PCM Cost per Line in Current \$

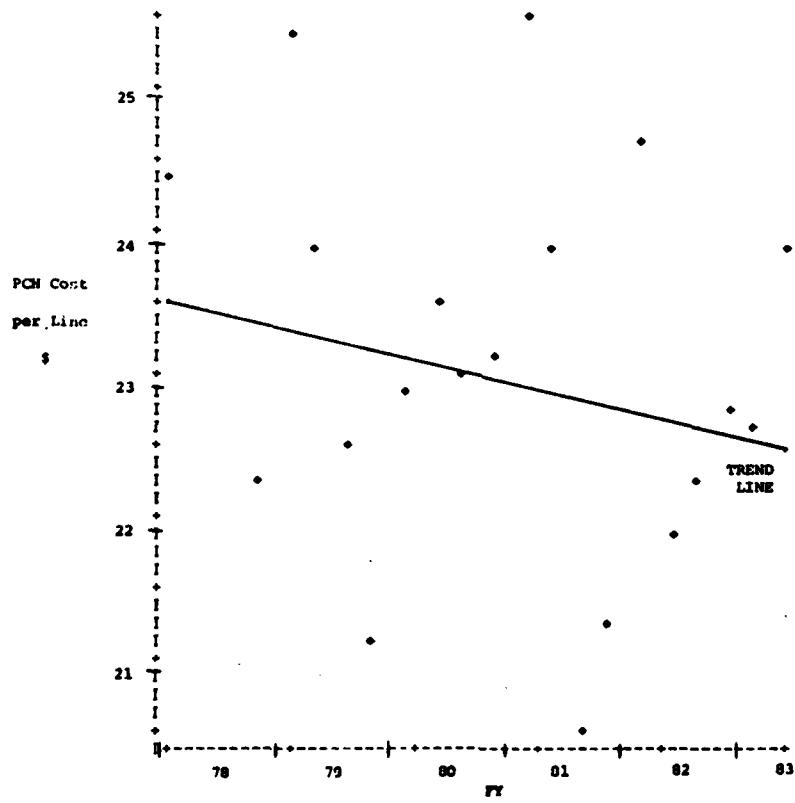


FIGURE 4. PCM Cost per Line in Constant \$ FY 83

a. Linear regression would provide the simplest and least expensive method of periodically reviewing the PCH cost. However, to obtain reliable results, accurate dollar value data should be made available.

b. Dollar value data should be used. If dollar value data were available, then model (2) could be utilized. This model should give much more accurate results than were obtainable in this study using the partial model (4). The depot computers have access to a price field for each line item shipment. Present depot computer programs accumulate line item counts and tonnage by customer type - FMS, Grant Aid, etc. - and item manager MSC. Modification of these programs or development of new programs could then track accumulated dollar value of shipments by customer type.

c. Dollar values should be accurate. Care should be taken that the dollar values be approximately correct. On Army Stock Fund items the standard price is annually updated to consider the effects of inflation as well as any new purchase prices. The standard price for procurement funded items is only updated when a new "representative buy" procurement has been recorded. Thus, the standard price for procurement funded items may be lower than the price charged to foreign customers. One reason is that the FMS procurement contract may be for less than an economic buy quantity. Also, the standard price may be outdated and, thus, due to inflation, be less than the current price for even an economic buy quantity. Therefore, on procurement

items, the unit price used by the computer should either come from the selling price estimate provided by the item manager on the Materiel Release Order (MRO) or from a list of estimated current replacement prices. A source of estimated current replacement prices should be available soon within the Commodity Command Standard System (CCSS).

2. Sampling procedures. If a more precise estimate of the PCH rate is desired, a biannual sample data collection scheme could provide the validation required in AR 37-60. This approach would be relatively expensive and time consuming compared to the regression method. To be effective, extreme care would be required to ensure that a representative sample is taken. Based on the experience discussed in paragraph VI-B2, the following general suggestions are offered:

- a. Obtain a listing from the USASAC file to determine Army-wide FMS activity for the previous year.
- b. Determine a sample selection process that stratifies the sample by the relevant population factors identified in paragraph VI-B2 such as depot workload volume, dollar value of shipments, and commodity types.
- c. Conduct real time data collection rather than a retrospective estimation.
  - (1) Assign a central point of contact to plan, initiate data collection at each sampled depot, coordinate, and analyze.
  - (2) Assign data collectors at each depot to monitor the flow of selected transactions through the depot cycle.

These data collectors would either record manhours and material costs or validate cost data provided by PCH personnel.

d. Sample size determination could be an iterative process, depending on the variability of the previous sample.

3. Separate FMS Cost Centers. Separate cost centers for FMS work would result in more accurate measurements of the cost of processing shipments for foreign customers. This method could prove expensive if the small volume of FMS shipments processed causes inefficient use of the separate cost center resources. However, there are ways of minimizing the extra associated cost. The cost of some functions - such as issuing items from bin storage - is probably no different for FMS than for other customers. Separate cost centers could be established for only those functions - such as exterior packing - whose costs are likely to depend on the type of customer.

#### VIII. Findings and Conclusions.

A. Given the available data sources, the cost of performing PCH work for FMS is difficult to compute or to estimate accurately.

B. There has been intermittent interest in estimating PCH cost for FMS work. A series of previous studies, both analytic and interpretative, produced estimated overall PCH cost rates for foreign customers ranging from 0.8% to 10.3%.

C. The PCH cost rate varies considerably among depots and is strongly influenced by the average shipment value and the total workload volume.

D. The PCH cost rate for FMS work at Red River Army Depot is approximately 5.5%.

E. The number of high cost items (those with unit price greater than \$50,000) is too small to statistically assess the adequacy of the present PCH surcharge formula for these items.

F. There is no apparent source for the total dollar value of shipments processed through Army depots. Furthermore, there is also no available data source for the total dollar value of FMS shipments processed through Army depots.

G. Linear regression analysis of total PCH costs and line item counts for both FMS and non-FMS shipments yields no statistical evidence that the present 3.5% surcharge rate for FMS shipments is invalid.

1. This regression technique was validated by applying the same analysis to data from Red River Army Depot and comparing the resulting cost estimate to the actual Red River PCH cost.

2. The precision of this regression technique for estimating the PCH cost was low. Greater precision should be achievable if dollar values of total FMS and of total non-FMS shipments were made available.

H. There are at least three methodologies to periodically review the PCH surcharge rate. In order of increasing cost and increasing precision, they are:

1. Linear Regression Analysis.
2. Stratified Sampling Procedure.
3. Establishment of separate FMS cost centers at Army depots.

#### IX. Recommendations.

A. The present 3.5% surcharge rate should be continued for items with unit price less than \$50,000.

B. For items with unit price exceeding \$50,000, the surcharge rate should not be used. Instead, FMS customers should be charged the actual or estimated PCH cost.

C. The Depot Operations Cost and Performance Report (DOCPNR), published by the Depot System Command, should be modified to include dollar values (i.e., replacement or actual selling prices) of both total FMS and total non-FMS shipments.

D. Biannual reviews of the PCH surcharge rate should be performed using linear regression analysis applied to line count and dollar value data from the DOCPNR.

E. Concurrent with biannual review of the overall PCH costs and surcharge rate, regression analysis should also be used to estimate the PCH cost rate at each depot with considerable FMS shipment volume. Any significant differences in individual depot cost rates should then be further evaluated.

## REFERENCES

1. US Army Logistics Management Center, Security Assistance Reference Book, August 1981, ALM-45-2268-RB(A).
2. US General Accounting Office, Improvements Are Needed to Fully Recover Transportation and Other Delivery Costs Under the Foreign Military Sales Program, 19 August 1977, LCD-77-210.
3. Oglar, Anwar MAJ, US Pricing Policy of Foreign Military Sales Materiel and Services, student paper, Florida Institute of Technology, June 1982, DLSIE LD 50395A.
4. US Army Depot Systems Command, Internal Review IR-6-78, Foreign Military Sales, 3 August 1978.
5. US Army Depot Systems Command, Depot Operations Cost and Performance Report, quarterly, RCS DRCMM-305.
6. DODI 2140.1, Pricing of Sales of Defense Articles and Defense Services to Foreign Countries and International Organizations, 7 March 1967.
7. Noll, Michael, Packaging Cost Study: Military Packaging Versus Commercial Packaging, April 1975, DLSIE LD 34252A.
8. Memo, Deputy Assistant Secretary of Defense (Comptroller), subject: Evaluation of the Standard Packing, Handling and Crating Percentage Prescribed for FMS Shipments, 7 June 1977.
9. Army Regulation 37-60, Pricing for Materiel and Services, 9 February 1978.
10. Army Regulation 37-60, Pricing for Materiel and Services, 15 April 1983.
11. US Army Materiel Development and Readiness Command, Project Report 27-77, Analysis of Depot Packaging Cost Reporting, December 1978.
12. US Army Depot Systems Command, Internal Review IR-25-80, 2nd Follow-Up Review of Foreign Military Sales (FMS), 22 August 1980.
13. Davis, Paula, Red River Army Depot Fact Sheet, subject: Packing, Crating and Handling (PC&H) Cost in Support of IL Shipments, 6 July 1983.

14. DOD 7290.3M, Foreign Military Sales Financial Management Manual, 29 June 1981.
15. Army Regulation 37-100-XX, The Army Management Structure (AMS), effective 1 October 19XX.
16. Report, OASD(C) (P/B) Plans and Systems Directorate, subject: DOD Deflators (Outlays), 24 August 1982.
17. US Army Security Assistance Quarterly Review, 4th Quarter FY 82, RCS CSGLD-1868.

**APPENDIX A**

Extract from AR 37-100-81

**The Army Management Structure (AMS)**

**Code**

**Activity and performance factor definitions**

**100000-00000  
720000-00000** • **CENTRAL SUPPLY & MAINTENANCE**

**Included are**

- a. Supply depot operations.
- b. Supply management operations.
- c. Central procurement activities.
- d. Base operations.
- e. Logistics administrative Support.
- f. Headquarters Headquarters.
- g. First Destination Transportation.
- h. Second Destination Transportation.
- i. Industrial preparedness Operations.
- j. Logistics Support Activities.
- k. Overseas Port Operations.
- l. Auto Visual.
- m. Real Estate Administration and Construction Supervision.
- n. Commissary Operations.
- o. Troop Subsistence Activities.

**PFR:** None

**SUPPLY DEPOT OPERATIONS**

**o. Provides for internal operations at Army depots and arsenals. Included are**

- (1) Receipts, storage, issues, and shipment of assigned stocks.
- (2) All related operations.

**(3) Stock control activities and administrative portions of traffic management within depots.**  
b. The following definitions apply throughout the series of accounts:

- (1) Ammunition.
- (2) Included are Army, Navy, Air Force, and Marine Corps ammunition as defined in AR 310-25.
- (3) The ammunition consists of conventional, missile, special weapon (nuclear), chemical, biological, radiological, and other selected types.
- (4) Excludes industrial ammunition prior to first destination transportation delivery.
- (5) Conventional ammunition material. This material consists of small arms through the largest artillery projectiles. Included are grenades, aerial bombs, pyrotechnics, mines, 2-inch to 9-5-inch rockets, armors, propellants, fuses, detonators and explosive demolition blocks.
- (6) Missile and rocket material. This material includes guided missiles and large rockets. It excludes ground guidance systems and launchers.
- (7) Chemical material. This includes only chemical ammunition.
- (8) Nuclear weapons material. This includes nuclear weapon ammunition and related items.
- (9) Other supplies exclusive of ammunition. Included are

  - (a) Civil Defense-owned materiel.
  - (b) Disposed-of materiel.

**721111-00003** •



The following is a list of the names of the members of the Board of Directors of the Bank of America, as of December 31, 1945:

Other Supplies

12111.12114

**Packing for Shipment**

Provides for that packing of supplies which is incident to unloading for shipment.

PF:

- (1) The quantity of final (exterior) containers filled and marked for supplies to be unloaded for shipment.
- (2) Short lists packed for shipment during reporting periods.
- (3) Quantities marked.

121111.12110

(11) The quantity of final (interior) containers filled and ready for transport to a disposal facility or storage facility.

(12) Short tons passed for shipment and/or storage during reporting period.

(13) Short tons passed for shipment and/or storage during reporting period.

(14) Short tons passed for shipment and/or storage during reporting period.

(15) Short tons passed for shipment and/or storage during reporting period.

(16) Short tons passed for shipment and/or storage during reporting period.

(17) Short tons passed for shipment and/or storage during reporting period.

(18) Short tons passed for shipment and/or storage during reporting period.

(19) Short tons passed for shipment and/or storage during reporting period.

(20) Short tons passed for shipment and/or storage during reporting period.

(21) Short tons passed for shipment and/or storage during reporting period.

(22) Short tons passed for shipment and/or storage during reporting period.

(23) Short tons passed for shipment and/or storage during reporting period.

(24) Short tons passed for shipment and/or storage during reporting period.

(25) Short tons passed for shipment and/or storage during reporting period.

(26) Short tons passed for shipment and/or storage during reporting period.

(27) Short tons passed for shipment and/or storage during reporting period.

(28) Short tons passed for shipment and/or storage during reporting period.

(29) Short tons passed for shipment and/or storage during reporting period.

(30) Short tons passed for shipment and/or storage during reporting period.

(31) Short tons passed for shipment and/or storage during reporting period.

(32) Short tons passed for shipment and/or storage during reporting period.

(33) Short tons passed for shipment and/or storage during reporting period.

(34) Short tons passed for shipment and/or storage during reporting period.

(35) Short tons passed for shipment and/or storage during reporting period.

(36) Short tons passed for shipment and/or storage during reporting period.

(37) Short tons passed for shipment and/or storage during reporting period.

(38) Short tons passed for shipment and/or storage during reporting period.

(39) Short tons passed for shipment and/or storage during reporting period.

(40) Short tons passed for shipment and/or storage during reporting period.

(41) Short tons passed for shipment and/or storage during reporting period.

(42) Short tons passed for shipment and/or storage during reporting period.

(43) Short tons passed for shipment and/or storage during reporting period.

卷之三

卷之三

ACTIVITIES AND SPECIAL FEATURES

## Code

## Activity and performance factor definitions

721111-12300

Bulk Issue

Selecting material for bulk issue and bin replenishment; physical handling and movement of material from initial point of permanent storage to backing, preservation bins locations, shop stores, servants, ready issue stores, etc., or designated shipping or assembly/disassembly area when no intermediate operations are necessary prior to consolidation of materiel being issued.

Includes processing of documentation, supervision, and clerical effort incident to above, such as receipt of issue document, checking recordings, and extracting information for issue documents.

Excludes physical handling for issuance of material from one bulk storage location to another when movement is associated with rework/holding; physical handling, selecting, and loading/offloading of material to and from preservation, decking, and docking areas or repair shops for minor repairs when such operations are associated with care of materiel in storage and CDSIS.

- PF: (1) Short Tons removed from storage  
 (2) Line Items removed from storage  
 (3) Man-hours worked

721111-12300

Bin Issue

Selecting material for bin issue; movement of material from bin storage area to packing, preservation, consolidation or other areas; identification marking of material issued; bin replenishment or bin storage of new receipts; including opening the container, checking contents, and marking materials; and placement of material into bins.

Includes documentation supervision, clerical effort, and cleanup of work areas incident to receipt of material and movement of material within bin storage area incident to receipt and/or issues.

Excludes physical handling of movement of material from one bin location to another for reasons of stock consolidation or as a result of stock number changes; physical handling and loading/unloading material for movement to or from preservation, packaging, and docking areas when such operations are incident to care of materiel in storage and CDSIS; physical handling incident to stock picking or bin replenishment of materiel stored within ship stores, servants, repair or rebuild shops, and other ready issue activities.

- PF: (1) Line Items removed from bin storage during the report period.  
 (2) Man-hours worked.

00421-1111121

Shipping

**Preparing, loading, and securing of materiel for shipment, including local or station delivery, physical handling and movement of material from point of permanent storage or consolidation point to the transportation vehicle when all movement is within normal forklift travel distance; loading of materiel into the transportation vehicle; and the operation of materiel handling equipment incident to loading.** Above definition is applicable as it pertains to shipments to customers, shipments to property disposals, interdecom shipments, and the intradecom movement of stock to decom maintenance when it is Johnson if stocks will be issued to a customer or returned to storage after work is completed. Includes off-loading at Central Shipping Areas, physical handling; segregation and consolidation required to assemble final shipping containers into Shipment Units (MILSTAMP) blocking, bracing, cushioning, dunnage, consolidation of final shipping containers offered for shipment and operations incidental thereto (such as strapping, marking, etc.); and closing of containers and item count; cleaning outgoing materiel as to number of containers and item count; cleaning transportation vehicle prior to loading and cleaning area after unloading; and supervision and clerical effort related to shipping such as receipt of shipping documents from traffic control or other appropriate source.

**Excludes movement of materiel after loading in transportation vehicle; all operations performed for purpose of providing a suitable level of pack to a final shipping container (use of jacks, to afford special protection or to construct mount outs, warehousing unit sets); and transportation documentation; shipment of containers from containerization/consolidation points (chargeable to transhipment).**

- PT: (1) Short Tons shipped.
- (2) Line Items shipped.
- (3) Man-hours worked.

721111-1244C

721111-12900

**Other Support:** (1) Short Tons shipped.  
 (2) Line Items shipped.  
 (3) Man-hours worked.

**Packing and issue support** Overall supervision, clerical and service support that is applicable to more than a single function area within packing and issue operations (+120000). Includes reclassification of labor (i.e., separating the reclaimable lumber from nonreclaimable lumber; disassembling railcar gats; removing nails or sawing off the supports to reuse it; reusable and stacking lumber in uniform sizes).

Code

Activity and performance factor definitions

721111.13300

Preservation and Packaging

Provides for preservation, reservation and packaging of material to be stored in storage or to be shipped. Includes linking, belting, cleaning, dipping, spraying and application of preservatives and interior packaging, painting, and masking.

Packaging includes all operations up to but not including selection of final (exterior) shipping container for other supplies; for ammunition the application of final flexible shipping container, palletizations, unitization, strapping, sealing, studding, stretching, marking, masking, and fitting part to complete the integral part of the preservation and packaging operation; handling/packing, augment within the area and loading processed material for storage, resealing, reshipping, and packaging areas; preservation and packaging of materials preserved and packaged for storage in quantities to be determined.

PF: (1) Number of packages of material preserved and packaged for movement to other areas;

(2) Short tons preserved and packaged.

721111.13310

Shipment

All activity and operations required in account 13300 when the effort is incurred to ship material and packages for shippers.

PF: (1) Number of packages of material preserved and packaged for shipment.

(2) Short tons preserved and packaged.

721111.13314

Other Sublimates

PF: (1) Number of packages of material preserved and packaged for shipment.

(2) Short tons preserved and packaged.

721111.13400

Container Assembly or Manufacture

Assembly and manufacture of integral parts of containers and packaging containers for installation in CONEX or other packages, separators, etc., as an assembly or component of containers for which they are used, loading or processing containers, and supervision and clerical transportation containers; disassembly of stock items to be shipped into bins, racks, separators, etc.; assembly or components of containers for access to other accounts; bins, and classes received from external sources for operating units.

PF: (1) Containers assembled/manufactured or devices completed.

(2) Man-hours worked.



**Hours worked.**

and the government's failure to take steps to protect the environment or to deal with documents.

**Excludes:** insurance coverage of the equipment, packing, marking, and loading.

carriers providing transbordal services to precipitate supply and demand for improved existing services.

tariff system entering into force.

outbound clients preparing frequent decisions about their business operations.

THE JOURNAL OF CLIMATE

presenting

Die Ergebnisse der Untersuchungen zeigen, dass die Anwendung von *Urtica dioica*-Extrakt bei der Behandlung von Akne-Patienten zu einer signifikanten Verbesserung der Aknegerüste führt. Die Ergebnisse bestätigen die Wirksamkeit und Sicherheit von *Urtica dioica*-Extrakt in der Behandlung von Akne.

and incident to effective supervision of all functions incident to effective

ACTIVITY AND BEHAVIOR DEVELOPMENTS

๘๙

Treat

7211-1-80001

A-8

APPENDIX B  
RED RIVER ARMY DEPOT DATA

YR	QTR	PCH (\$1000)	LINES			INFLATION		FREIGHT		
			FMS	AID	TOTAL	MAT	LAB	RECV	SHIP	(\$1000)
78	1	5123	11422	1575	291688	.6284	.7256	44642	222958	462
78	2	4978	6977	1371	310455	.6390	.7390	45427	227394	454
78	3	5647	14622	1091	336248	.6536	.7501	40939	249909	525
78	4	5974	12271	718	329434	.6681	.7612	31032	315619	532
79	1	6379	13793	956	315369	.6827	.7722	29861	245080	553
79	2	6258	11200	277	310007	.6972	.7833	28353	272449	552
79	3	5565	9296	460	318700	.7141	.7967	32110	260672	585
79	4	5035	7011	926	291740	.7310	.8100	31748	238802	528
80	1	5859	7190	661	280076	.7479	.8234	26838	257345	610
80	2	7074	12285	384	310555	.7648	.8367	20270	244585	619
80	3	6109	13227	313	320421	.7876	.8549	25540	274730	623
80	4	6302	12080	139	304168	.8103	.8731	43940	173319	623
81	1	7426	9474	20	305136	.8331	.8912	29654	264777	711
81	2	7402	11599	696	313375	.8558	.9094	28959	267285	736
81	3	7063	10602	787	329025	.8755	.9218	25742	278647	755
81	4	6671	7642	662	347589	.8952	.9342	34575	271993	695
82	1	7309	8395	3816	317522	.9149	.9465	0	183397	810
82	2	7163	9030	143	326536	.9346	.9589	0	255642	765
82	3	7860	9033	872	363273	.9510	.9692	0	255900	821
82	4	7512	6954	277	340610	.9673	.9795	0	251573	824
83	1	8234	5808	269	355573	.9837	.9897	0	253605	748
83	2	8935	10091	568	371643	1.0000	1.0000	0	324456	765

APPENDIX C  
COMBINED ARMY DEPOT DATA

YR	QTR	PCH (\$1000)	LINES			INFLATION		FREIGHT		
			FMS	AID	TOTAL	MAT	LAB	RECV	SHIP	(\$1000)
78	1	23563	104128	6965	1340037	.6284	.7256	217046	514300	2635
78	2	24029	136463	6456	1385776	.6390	.7390	230556	546278	2700
78	3	18318	4745	4701	1442599	.6536	.7501	237002	582908	3011
78	4	26617	87079	3210	1564039	.6681	.7612	403977	744355	2837
79	1	28560	72808	3693	1475650	.6827	.7722	220980	531498	3141
79	2	29349	60397	2136	1572274	.6972	.7833	245977	600194	3310
79	3	27781	59319	3342	1558380	.7141	.7967	262094	567857	3111
79	4	24073	60099	6747	1416943	.7310	.8100	220864	534987	2747
80	1	26491	51245	4279	1412320	.7479	.8234	208640	512260	3051
80	2	29399	71380	1906	1497999	.7648	.8367	204960	573098	3226
80	3	29128	83315	1583	1556652	.7876	.8549	239015	602894	3255
80	4	30488	73018	1020	1485121	.8103	.8731	288023	523007	3185
81	1	32113	61139	830	1417082	.8331	.8912	231041	549274	3292
81	2	32042	69803	1981	1474317	.8558	.9094	246084	564045	3583
81	3	29448	69913	1434	1557339	.8755	.9218	250113	647847	3732
81	4	31519	56917	1268	1582622	.8952	.9342	250247	597073	3956
82	1	35150	55902	7451	1511463	.9149	.9465	182021	1099427	3863
82	2	34738	85508	549	1651281	.9346	.9589	193266	536985	4020
82	3	36104	85801	1509	1668380	.9510	.9692	259792	958024	4331
82	4	35418	77868	553	1591766	.9673	.9795	209357	940908	4292
83	1	35624	80856	456	1599036	.9837	.9897	157948	870143	3518
83	2	39491	63667	710	1652458	1.0000	1.0000	162366	824229	3990

## APPENDIX D

### ACRONYMS

AMS	Army Management Structure
ANAD	Anniston Army Depot
AR	Army Regulation
DARCOM	US Army Materiel Development and Readiness Command
DESCOM	US Army Depot Systems Command
DLA	Defense Logistics Agency
DLSIE	Defense Logistics Studies Information Exchange
DOCPR	Depot Operations Cost and Performance Report
DOD	Department of Defense
DSS	Direct Support System
FMS	Foreign Military Sales
GAO	General Accounting Office
IL	International Logistics
LEAD	Letterkenny Army Depot
MRO	Materiel Release Order
NCAD	New Cumberland Army Depot
OMA	Operations and Maintenance, Army
OS	Other Supplies
PCH	Packing, Crating, and Handling
PUAD	Pueblo Army Depot
RRAD	Red River Army Depot
SDS	Standard Depot System
TOAD	Tobyhanna Army Depot
UPS	United Parcel Service
USASAC	US Army Security Assistance Center
WTCV	Weapons and Tracked Combat Vehicles

END

FILMED

12-84

DTIC